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10 (Amended). A method for recovering nickel from nickel-containing soil comprising:

- (a) elevating the pH of the soil from an initial pH to a raised pH of at least 5.6;
- (b) cultivating at least one nickel-hyperaccumulator plant in the soil having the raised pH under conditions such that at least 0.1% of the above-ground tissue of said at least one plant, on a dry weight basis, is nickel;
- (c) harvesting said at least one plant; and
- (d) recovering nickel from said harvested plant.

Please add new claims 48 as follows.

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48 (New). The method of claim 1, wherein the at least one metal is selected from the group consisting of nickel, cobalt, palladium, rhodium, ruthenium, platinum, iridium, osmium, rhenium and mixtures thereof.

REMARKS

Claims 1-47 are pending. Claims 5-7, 19-37, and 41-47 have been withdrawn from consideration due to a previous Restriction Requirement. Claims 1-4, 8-18 and 38-40 are therefore being examined on the merits. Claims 1-4, 8-18 and 38-40 are amended and new claim 48 added. Support for the amendments and new claims can be found throughout the application, for instance at page 8 of the specification and in the claims as originally filed. No new matter has been added.

Applicants wish to respond to the comments of the Office Action of January 24, 2002. In the Office Action, claims 1-4 and 38-40 were rejected under 35 U.S.C. §112, first paragraph, as lacking enablement. It is alleged that it would require undue experimentation in order to characterize non-Brassicaceae hyperaccumulators and to develop optimum methods and soil conditions that would permit the accumulation of metals.

Applicants respectfully disagree. Applicants point out that page 8, line 25 through page 9, line 1 provides enabling disclosure as how to raise soil pH. Indeed, the raising of pH is even more clear as the claims have been amended as indicated herein to indicate that soil pH is elevated from an initial pH to a raised pH of at least 5.6. As for fertilizers and chelating agents, page 18, line 6 through page 19, line 24 provides enabling disclosure on which additional ingredients would be useful for providing suitable conditions for metal hyperaccumulation by hyperaccumulator plant species.

Perhaps more important, Applicants point out that the phrase "metal-hyperaccumulator" is well known to those of ordinary skill in the art. As evidence of such knowledge in the art, Applicants submit herein (with an Information Disclosure Statement) the reference Baker & Brooks, Terrestrial Higher Plants which Hyperaccumulate Metallic Elements - A Review of their Distribution, Ecology and Phytochemistry, *Biorecovery*, Vol. 1, 81-126, 1989 (hereinafter "Biorecovery"). As noted in the Abstract at the first page of the reference, the hyperaccumulator phenomenon is known in the art to be widespread throughout the plant kingdom, a unifying feature of hyperaccumulating plants being their general restriction to mineralized soils and specific rock types. The reference also indicates that a variety of metal hyperaccumulators and their definitions are known in the art, including hyperaccumulators of Co, Cu, Cr, Pb, Ni, Mn and Zn. Hyperaccumulators of Co, Cu, Cr, Pb and Ni can be defined as plants containing over 1,000 µg/g (ppm) of any of these metals in the dry matter, while for hyperaccumulators of Mn and Zn, the criterion is 10,000 µg/g (1%) (See Abstract). Indeed, the following is noted in the present application:

By definition, nickel-hyperaccumulating plants accumulate at least about 1000 mg of nickel per 1 kg dry weight of plant tissue (obtained from a plant grown in soil where the plant naturally occurs). Similarly, cobalt-hyperaccumulating plants are defined as plants that accumulate at least about 1000 mg of cobalt per 1 kg dry weight of plant tissue (obtained from a plant grown in soil where the plant naturally occurs). However, zinc- and manganese-hyperaccumulators are defined as plants that accumulate at least about 10,000 mg of zinc and manganese, respectively, per 1 kg dry weight of plant tissue (obtained from a plant grown in soil where the plant naturally occurs). Finally, cadmium-hyperaccumulators are defined as plants that accumulate at least about 100 mg cadmium per 1 kg dry weight of plant tissue (obtained from a plant grown in soil where the plant naturally occurs).

(See page 10, lines 7-18 of the specification). The reference further demonstrates that a variety of metal-hyperaccumulator plants other than Brassicaceae as known in the art. At Table 2, the *Biorecovery* reference lists 26 hyperaccumulators of cobalt as well as 24 hyperaccumulators of copper, as defined above ($>1,000 \mu\text{g/g}$). Table 4 includes data for a number of hyperaccumulators of lead ($>1,000 \mu\text{g/g}$). Hyperaccumulators of manganese ($>1,000 \mu\text{g/g}$) are included in Table 5. Table 6 lists 145 hyperaccumulators of nickel ($>1,000 \mu\text{g/g}$) that had been discovered at the time of the *Biorecovery* reference (See also Tables 7-9). In addition, a variety of non-Brassicaceae hyperaccumulators of zinc ($>10,000 \mu\text{g/g}$) are set forth in Table 10. Finally, page 10, line 24 through page 17, line 31 of the specification provides an exhaustive list of hundreds of plant species useful in the present invention. Clearly, metal-hyperaccumulators other than Brassicaceae hyperaccumulators are well known in the art. Applicants point out that the test of enablement is whether one reasonably skilled in the art could make or use the invention from the disclosure in the patent coupled with information known in the art without undue experimentation. *United States v. Telectronics, Inc.*, 8 USPQ 2nd 1217, 1223 (Fed. Cir. 1988). Given the knowledge available in the art as well as the guidance set forth in the application regarding metal-hyperaccumulators, Applicants respectfully submit that there is no "undue" experimentation such that an enablement rejection should stand.

Claims 1-4, 8-18 and 38-40 were also rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable under claims 1-5 of U.S. Patent No. 5,711,784. Applicants respectfully point out that this rejection is moot in light of the Terminal Disclaimer filed on May 1, 2002.

Finally, claims 1-4, 8, 10, 12-13, 16-18 and 38-40 were rejected under 35 U.S.C. §103(a) as being unpatentable over Raskin et al. (U.S. Patent No. 5,785,735). It is alleged that since Raskin discloses balancing a higher pH for optimal Brassicaceae growth and a lower pH for increased metal availability, Raskin suggests the step of elevating pH for increasing Brassicaceae growth, especially towards harvest for increased metal mobility.

Applicants respectfully disagree. Applicants note that in preferred embodiments the present invention is concerned with a method for selectively increasing the amount of at least one metal recovered from metal-containing soil comprising: (a) elevating the pH of the soil from an initial pH to a raised pH of at least 5.6; and (b) cultivating at least one metal-hyperaccumulator plant in the soil having the raised pH under conditions sufficient to permit said at least one plant to accumulate said at least one metal from the soil in above-ground tissue. In other preferred embodiments the present invention is concerned with a method for recovering nickel from nickel-containing soil comprising: (a) elevating the pH of the soil from an initial pH to a raised pH of at least 5.6; (b) cultivating at least one nickel-hyperaccumulator plant in the soil having the raised pH under conditions such that at least 0.1% of the above-ground tissue of said at least one plant, on a dry weight basis, is nickel; (c) harvesting said at least one plant; and (d) recovering nickel from said harvested plant.

No such invention is taught or suggested by the prior art. Raskin discloses the removal of metals from metal-containing soil using plants of the family Brassicaceae (See column 1, lines 30-32). However, Raskin discloses that such removal of metals is by, among other possible methods, decreasing pH of the metal-containing soil to at least pH 5.5 or less (See column 1, lines 57-65). Raskin also discloses that conventional methods of growing Brassicaceae generally require soil in the pH range 5.8-6.2 for optimum production (See column 7, lines 58-60). Raskin therefore does appear concerned with maintaining the production of Brassicaceae so that the removal of metals through a decrease in the pH of metal-containing soils is possible. However, Raskin makes it clear that the balancing of plant production and metal removal is achieved by "dropping" the pH of the metal-contaminated soil to about 4.5-5.5 (See column 8, lines 1-2), even though yields of Brassicaceae are reduced at pH levels below about 5.5 (See column 8, lines 25-26). As clearly noted in column 8, the methods of Raskin "require a balance between reduction in growth potential due to increased soil acidity and increase in availability of metals in metal-contaminated soils due to lowered pH" (See column 8, lines 26-29).

The present invention, on the other hand, is concerned with a metal recovery whereby the pH of the soil is elevated from an initial pH to a raised pH of at least 5.6. Raskin does not teach or suggest any such invention, and indeed, may be considered to teach away from pH elevation as in the present invention. As explained above, Raskin teaches that decreasing the pH of the metal-containing soil to at least pH 5.5 or less with the concomitant reduction in yields of Brassicaceae is necessary for the removal of metals. Raskin clearly does not teach or suggest that metal removal can be accomplished through an elevation in soil pH, much less elevating the pH of the soil from an initial pH to a raised

pH of at least 5.6. Indeed, in teaching that "decreasing", "dropping" or "lowering" the pH to 5.5 or less is necessary for metal removal, Raskin can only be considered to teach away from the present invention. Applicants urge withdrawal of the rejection.

Claims 1-4, 8-18 and 38-40 were also rejected under 35 U.S.C. §103(a) as being unpatentable over Raskin and further in view of Brooks et al. (1981). It was alleged that it would have been obvious to modify the teachings of Raskin by incorporating the specific teachings of Brooks as to how selectively remove nickel from nickel-contaminated soil by using specific *Alyssum* species.

Applicants respectfully disagree. The present invention has been discussed above.

As noted above, Raskin teaches that decreasing the pH of metal-containing soil to at least pH 5.5 or less along with a reduction in yield is necessary for the removal of metal from the soils. This teaching is completely contrary to the present invention, which elevates the pH of the soil from an initial pH to a raised pH of at least 5.6 in order to recover metals from soil. For this reason alone, no additional reference could render the present invention obvious, when combined with Raskin. According to the case *W.L. Gore & Associates, Inc. v. Garlock, Inc.*, 220 USPQ 303 (Fed. Cir 1983), a prior art reference must be considered in its entirety, including portions that lead away from the claimed invention. Since the Raskin reference is completely contrary to the present invention, no added reference could overcome the failure of Raskin to teach the invention. Nevertheless, Applicants point out that Brooks also fails to teach or suggest any elevation of soil pH from an initial pH to a raised pH of at least 5.6. Therefore, in that no combination of the cited references can be considered to teach or suggest the present invention, Applicants urge withdrawal of the rejection.

In the event this paper is not considered to be timely filed, Applicants hereby petition for an appropriate extension of time. The fee for this extension may be charged to our Deposit Account No. 01-2300. The Commissioner is hereby authorized to charge any fee deficiency or credit any overpayment associated with this communication to Deposit Account No. 01-2300, referencing Attorney Docket No. 108172-00037.

Respectfully submitted,

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Enclosures: IDS with Baker & Brooks, Terrestrial Higher Plants which Hyperaccumulate Metallic Elements - A Review of their Distribution, Ecology and Phytochemistry, *Biorecovery*, Vol. 1, 81-126, 1989.

MARKED-UP COPY OF THE CLAIMS

1 **(Amended).** A method for selectively increasing the amount of at least one metal recovered from metal-containing soil comprising:

- (a) elevating the pH of the soil from an initial pH to a raised pH of at least 5.6; and
- (b) cultivating at least one metal-hyperaccumulator plant in the soil having the raised pH under conditions sufficient to permit said at least one plant to accumulate said at least one metal from the soil in above-ground tissue.

10 **(Amended).** A method for recovering nickel from nickel-containing soil comprising:

- (a) elevating the pH of the soil from an initial pH to a raised pH of at least 5.6;
- (b) cultivating at least one nickel-hyperaccumulator plant in the soil having the raised pH under conditions such that at least 0.1% of the above-ground tissue of said at least one plant, on a dry weight basis, is nickel;
- (c) harvesting said at least one plant; and
- (d) recovering nickel from said harvested plant.